San José, Costa Rica, July, 2021

Dear Dr. Valerio de Rubeis,
(Referee #1)

Below you will find a response and changes made to the manuscript, according to your revision. We are using the letter we received with your comments as a reference and marked in blue the changes or comments. We thank you for the observations provided and hope to have improved our study in order to be considered for the Editor in chief (decision) for publication.

1. The paper applies the methods of a previous interesting analysis on the perception of seismicity both from an instrumental point of view and from the perception of citizens during the lockdown period due to Covid-19. The analyzed data are in favor of an effective difference in instrumental and human perception between the period during the lockdown and the previous one. Although the analysis is interesting, the method of analysis is extremely simple: in essence it merely shows the difference in average values. There is no in-depth statistical analysis, nor are there any statistical tests to quantitatively support the results.

Thanks for your suggestion. First, we want to emphasize that the goal of our paper is to show and document in a simple and pragmatic way, the significant decrease of seismic noise due to the lockdown measures in Central America, and it is not an in-depth statical analysis of the seismic noise variation for each station. Therefore, we believe that basic observation is provided, showing a clear decrease of down to ~50% of the site noise level of a station for several subsequent weeks during the lockdown. These stations have been recoding data since years, and we document an unprecedented decrease of anthropogenic noise for all most of the stations described, except for Nicaragua, for which we give an explanation. Furthermore, we believe that the displacement values that we provide are already very quantitative, computed with a validated method (Lecocq et al., 2020b), used by many seismologists in dozens of different research papers.

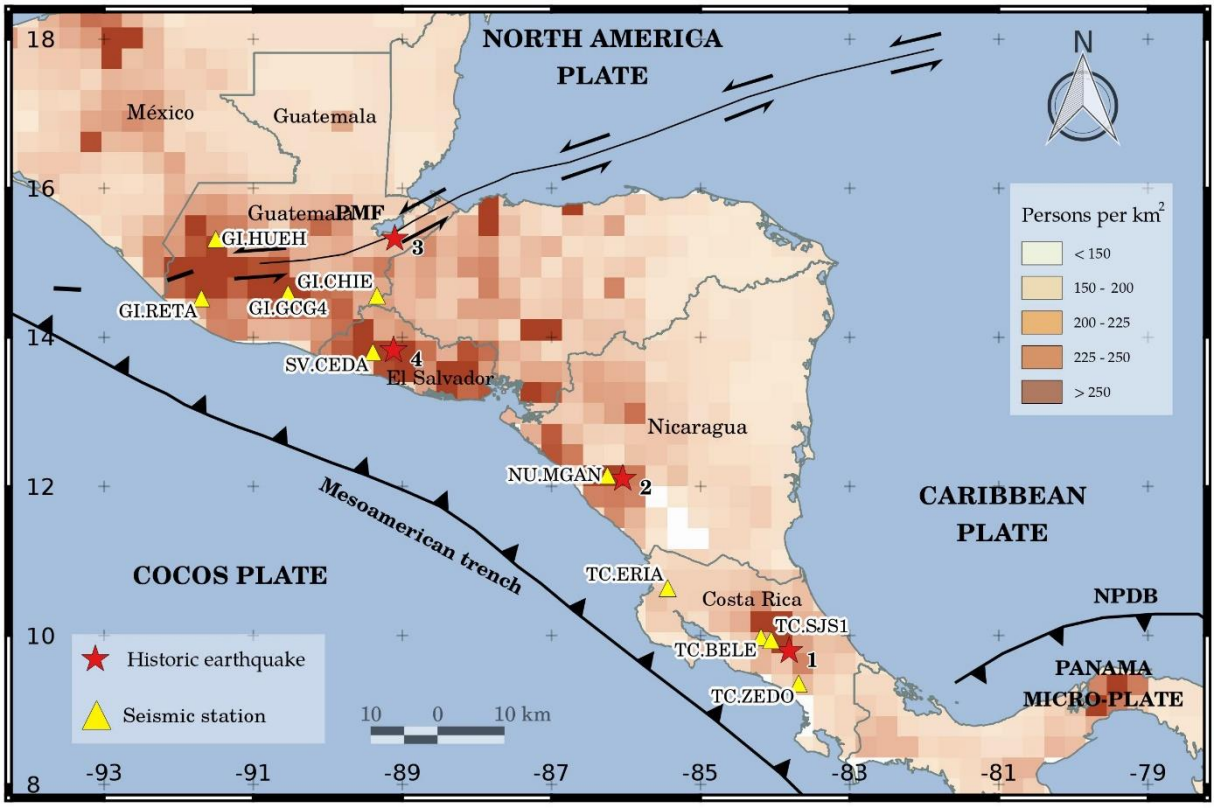
Having clarified that, to complement the analysis and to try to address your comment, we have added a new table to the appendix of the manuscript, as a simple statistically testing for the results, by doing a series of hypothesis tests for cases where there is an observed increase: null hypothesis of "no increase" vs. alternative hypothesis of "increase" (see Table A3 below). Besides, we added some general text about this exercise and to refer this new table in Section 3.2.

Table A3. Summary of observations when comparing the earthquake detections and felt reports from the time before the lockdown (BL) and during lockdown (DL) for Costa Rica and Guatemala (see also Figures 7, 8, 9, 10 and A2). The observations that favor an increase in the hypothesis of lower magnitude earthquakes (LM) are marked.

Observations	**Costa Rica**		**Guatemala**	
	M ≤ 3.5	M > 3.5	M ≤ 3.5	M > 3.5
Number of detected earthquakes	Slightly decrease	No change	Slightly increase (LM)	Increase
Number of picked phases	~20% increase (LM)	Slightly increase	~40% increase (LM)	No change
Number of Felt earthquakes	Increase (LM)	Decrease	No change	Increase
Number of felt earthquakes reports	No change	Increase	-----	
Mc	Slightly increase		Slightly increase	
a-value	Slightly decrease		Increase (LM)	
b-value	Slightly increase (LM)		Slightly increase (LM)	

2. Since these are anthropogenic effects on seismicity detection, there is no in-depth analysis of the anthropic component. For example, the population density map is appreciated, but why not introduce the numerical values of the aforementioned density to normalize the data of the stations?

Regarding to the density map and numerical values to analyze the anthropic component, we have added as a reference a color bar with the density population values to gives a better idea of the amount of geographic distribution of people (Figure 1, below). However, this density values are a coarse approximation, and we think that the normalization of the data through density values would bring bias to the analysis. We believe that it would show the same effect that is already presented. Furthermore, we think that to compare data from the registry of stations in different contexts and with different populations, might minimize the real impact of the decrease in seismic noise observed at each of these sites.



3. To demonstrate the increase in the number of earthquakes detected as a function of magnitude, why not present the b-value graphs before and during the L.D.?

We have followed the referee suggestion and performed the a- and b-value calculation for the seismic data of Costa Rica and Guatemala, for the two time periods, before (BL) and during (DL) lockdown. We also present the Gutenberg-Richter relationship graph for each data set and each period. To calculate these seismic parameters and their uncertainties, we used the classical maximum likelihood technique of Aki (1965) modified by Weichert (1980). This method solves the likelihood function for grouped magnitudes and unequal periods of observation based on the Magnitude of completeness (Mc). To run this methodology, we used the OpenQuake software (GEM, 2020). The Mc was estimated by means of the MAXC method, which corresponds to the maximum point in the non-cumulative graph of the Gutenberg-Richter relationship (e.g. Wiemer and Wyss, 2000; Woessner and Wiemer, 2005). For Costa Rica the Mc was determined on 2.9 BL (Fig. a) and 3.0 DL (Fig. b) and for Guatemala on 3.7 BL (Fig. c) and 3.8 DL (Fig. d). These values seem to show that the impact of the lockdown measures in the detected earthquakes is not big enough to change the Mc.

We present these results in this response letter and as a complement in the Appendix material as Figure A2. Besides, we added some general text about this exercise in Section 3.2. We agree with the reviewer that this test is useful to check the increase in the number of earthquakes detected as a function of magnitude through the productivity rate (a-value) and the relationship

between low and high magnitude earthquakes (b-value). However, the a- and b- values are very sensitive to many aspects, including the instant within the earthquake cycle, magnitude conversions, time span, aftershocks and foreshocks, consistency of the observatory operations, etc, and we won't be able to isolate any change observe to associated with the lockdown.
We want to stress that we have focused our paper only in the documentation of the number of earthquakes detected and the seismic noise levels related to the lockdown measures. The interpretation of this temporal variability of the Gutenberg-Richter parameters and its use to infer earthquake rates and tectonic implications, may require more careful analysis, including a detailed seismic catalog processing and a wider time window, so we feel we cannot address that in the current manuscript without making it too long, and may need the addition of many more calculations and figures to make a good study case.

The new graphs added to address the reviewer suggestion show the Gutenberg-Richter relationship and the a- and b-values for each country, before and during the lockdown measures. As it can be seen in these figures, the b-value is very consistent and there are not significant changes. For Costa Rica, increasing from 0.76 to 0.77, with differences of less than the uncertainty range (+/- 0.02), and for Guatemala, it varies a little more, incrementing from 0.87 to 0.91. This could be explained as an increment in the rate of low magnitude earthquakes compared to high magnitude (i.e., an increment the slope of the Gutenberg-Richter curve). Unlike the b-value, the a-value presents a contrary trend for Costa Rica and Guatemala, but still very similar before and during lockdown. For Costa Rica it shows a slightly decrease from 3.62 to 3.56 and for Guatemala it increases from 4.43 to 4.63. This shows a general increment in the occurrence seismic rate for Guatemala and a decrease for Costa Rica during the lockdown, but again the observed changes are not easy to separate from other origins.

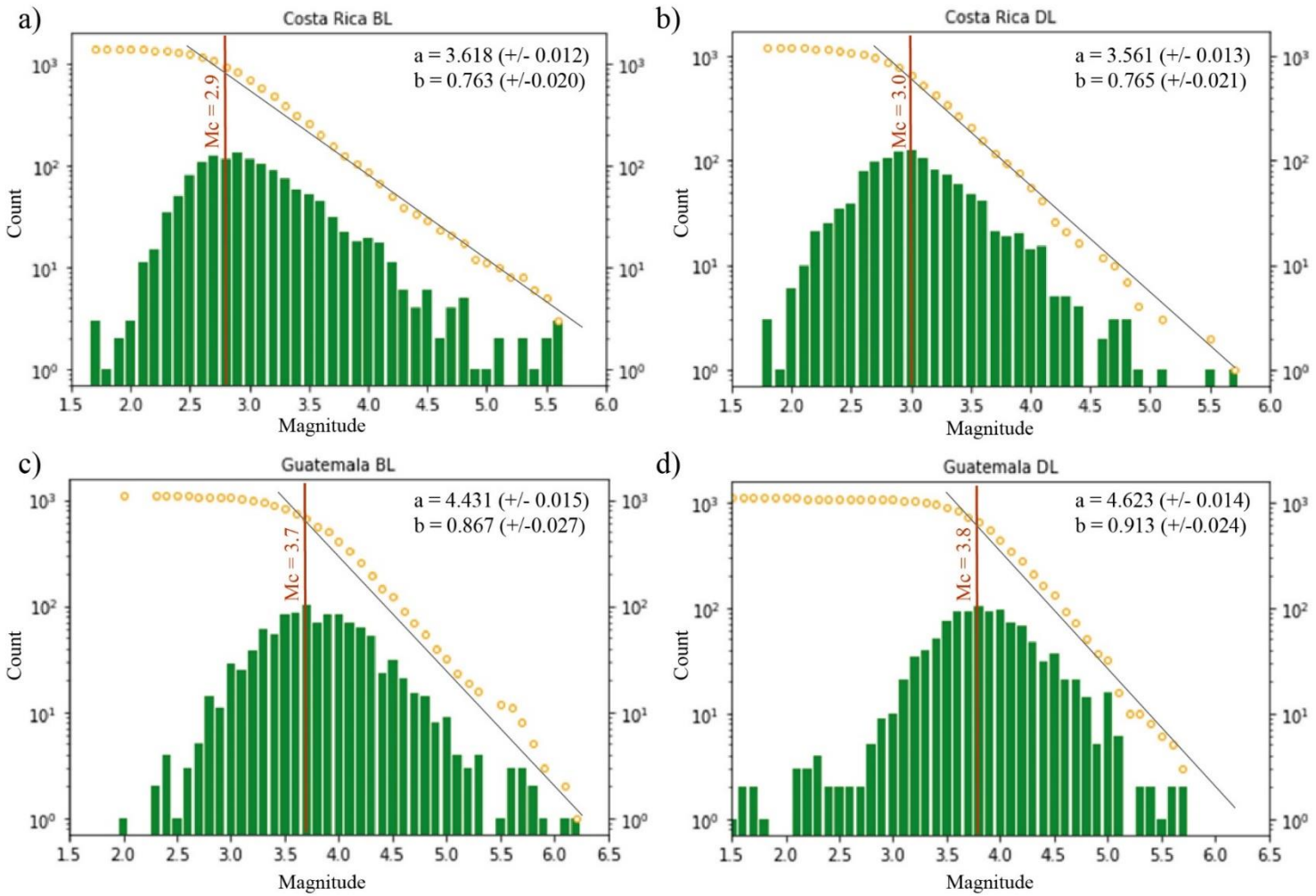


Figure A2. a) Magnitude-frequency distribution for earthquakes in Costa Rica before lockdown. b) Magnitude-frequency distribution for earthquakes in Costa Rica during lockdown. c) Magnitude-frequency distribution for earthquakes in Guatemala before lockdown. d) Magnitude-frequency distribution for earthquakes in Guatemala during lockdown. Green bars represent the incremental (non-cumulative) and yellow circles the cumulative distribution of earthquakes. The grey solid line fits the data points for the cumulative distribution for magnitude above Magnitude of completeness (Mc). Vertical lines indicate the Mc estimated from the maximum curvature (MAXC) method.

4. I believe that the work deserves on the one hand a satisfactory quantitative statistical analysis, on the other hand a reduction of the text which is, in my opinion, too verbose.

To address those aspects, we have improved our results as explained before in points 1 and 3.

5. Minor corrections are highlighted in the attached pdf file.

Thank you for the comments and the detailed revision. We have followed the corrections made according to the observations. All line numbers mentioned in this reply refer to line numbers in the manuscript version of the referee revision, without the track changes.

-Line 25: This kind of verification seems to be very indirect.

It is explained above in point 1, why we conducted the analyses in that way.

-Line 28: Remove "and"

It has been removed

-Line 81: Stations far from towns are important as comparison to evaluate the effects of lockdown reduced noise in towns.

In our analysis we wanted to explore data for stations close to large cities to demonstrate the effects in seismic noise levels in each of the countries selected. We believe the seismic noise levels will more dramatically change in cities, rather than in quiet stations in the country side. For Costa Rica and Guatemala, we also explored some stations in the countryside and near small towns.

-Line 140: Other aspect could be analized from macroseismic data

In our study we wanted to focus our analysis in low-magnitude events, as not large earthquakes occurred during the lockdown.

-Lines 195-201: Why not add further statistical analysis after the simple calculation of average values?

It is explained above in point 1. We have also added a Table and Figures in the Appendix.

-Line 278: is not what?

We missed a word. Thank you very much for the observation. The sentence is: "*Although the difference in the number of P wave arrivals before and during the pandemic* ***is not too much****…*"

Finally, we have added a line in the Acknowledgments Section to thank you for your suggestions.

Best Regards,

The authors